

**CONSERVATION STRATEGY FOR CLUSTERED  
LADY'S-SLIPPER ORCHID (*CYPRIPEDIUM FASCICULATUM*)  
IN U.S. FOREST SERVICE REGION 1**

by

**Juanita Lichthardt  
Conservation Data Center**

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**Idaho Department of Fish and Game  
Natural Resources Policy Bureau  
600 South Walnut, P.O. Box 25  
Boise, Idaho 83707  
Steve Huffaker, Director**



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## INTRODUCTION

*Cypripedium fasciculatum* (clustered lady's-slipper orchid) is a rare species of orchid with several disjunct ranges in the cordilleran western United States. Its abundance, and thus its conservation status, varies among the eight states in which it occurs. One of its ranges is in the northern Rocky Mountains of Idaho and Montana where all but a few of the known populations occur on lands managed by Region 1 of the U.S. Forest Service. *Cypripedium fasciculatum* (*Cyfa*) is ranked "sensitive" by the Forest Service. Therefore, when it occurs in a project area the impacts of the project on population viability must be addressed. This Conservation Strategy was written to provide guidance to Forest Service botanists, other specialists, and managers in managing for and conserving *Cyfa* throughout its range in Region 1. It begins with a summary of pertinent information about the species' biology and ecology, and gives an overview of its status in Region 1. A strategy is then outlined for maintaining viable populations of *Cyfa* throughout its range in Region 1, as required by Forest Service Policy (FSM 2670.5.22).

## CLASSIFICATION AND NOMENCLATURE

**Scientific name:** *Cypripedium fasciculatum* Kell. ex Wats.

**Synonyms:**

*Cypripedium pusillum* Rolfe

*Cypripedium fasciculatum* Rolfe var. *pusillum* Hooker f.

*Cypripedium knightae* A. Nelson

**Section:** Enantiopedilum (monotypic)

**Family:** Orchidaceae

**Common name:** Clustered lady's-slipper orchid

## PRESENT LEGAL OR OTHER FORMAL STATUS

### Global

The NatureServe (2002) network gives *Cyfa* a global rank of G4 (apparently secure, though it may be quite rare in parts of its range, especially at the periphery). The individual state ranks are shown in Table 1.

### Federal

*Cyfa* is not listed as threatened or endangered under the Endangered Species Act, and thus has no legal status according to the U.S. Fish and Wildlife Service. The species is designated as sensitive in Region 1 of the U.S. Forest Service (Idaho and Montana). Forest Service sensitive species are those identified by a Regional Forester for which viability is a concern, as evidenced by: a) significant current or predicted downward trends in population numbers or density, or b) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

State (for the portion of the species' range in Region 1 of the U.S. Forest Service)

**Montana:** *Cyfa* is ranked as S2 by the Montana Natural Heritage Program (MTNHP; Table 1).

**Idaho:** *Cyfa* is classified as Sensitive in Idaho by the Idaho Native Plant Society and is ranked as S3 by the Idaho Conservation Data Center (IDCDC; Table 1).

These state rankings do not carry any legal status in either state.

Table 1. NatureServe ranks for *Cypripedium fasciculatum*, and numbers of element occurrences (EO) by state (October 2002).

State	Rank <sup>1</sup>	Number of EOs
California <sup>2</sup>	S3	?
Colorado	S3	114
Idaho	S3	115
Montana	S2	31
Oregon	S2	316
Utah	S1	23
Washington	S2	66
Wyoming	S2	29

<sup>1</sup> S1 = Critically imperiled because of extreme rarity or because some factor of its biology makes it especially vulnerable to extirpation; S2 = Imperiled because of rarity or because other factors make it especially vulnerable to extirpation; S3 = Rare or uncommon but not imperiled.

<sup>2</sup> *C. fasciculatum* is ranked S3 in California but is not tracked.

## DESCRIPTION OF THE TAXON

### General description

*Cyfa* is easily identified even in the vegetative state. Plants are 6-12 inches high with unbranched stems and a single pair of large, oval, deep green, and glossy leaves attached near midstem (Appendix A). On the undersides, the leaves are glabrous (without hairs) and shiny. Stems are distinctly hairy below the leaves. Plants have one to several stems with drooping terminal clusters of 1-7 flowers. Flowers are slightly more than 0.5 inch across; the inflated, pouch-like lip is greenish-yellow with brownish-purple or purple margins, and the petals are brownish-purple. Two color variants also occur, sometimes in close proximity. In one, the petals are green with purplish lines and mottling, and in the other greenish-yellow with red lines (Keenan 1998).

### Technical description

Plants perennial, stem 0.5-3 dm (2-12 inches) tall, lanate-pilose, usually with a single sheathing bract near ground level, a pair of sub-opposite leaves at or well above midlength, and often 1 or 2 lanceolate bracts near the inflorescence; leaves sessile, broadly elliptic- to oblong-elliptic or elliptic-oval, mostly 4-8 cm (1.6-3.2) inches broad, rounded-obtuse to slightly acute; flowers (1)

2-4 (7) in a rather tight cluster, subtended by conspicuous greenish bracts; sepals lanceolate-acuminate, 12-25 mm (0.5-1 inch) long, greenish-brown or brownish-purple and usually purple-lined or -mottled, the lower pair fused completely or free at the tips only; petals similar to the sepals but usually somewhat broader; lip depressed ovoid, shorter than the sepals, greenish-yellow with brownish-purple margins and often with purplish tinge; staminodium 2.5-3 mm (0.1-0.2 inches) long, about equaling the longest lobe of the stigma. (Modified from Hitchcock 1969.)

#### Diagnostic characters

The pair of glossy green leaves borne well above the ground, and the hairy stem below the point of leaf attachment are distinctive.

#### Habit

*Cyfa* is a perennial from a short rhizome, that functions alternately as an autotroph (obtaining carbohydrates from photosynthesis), and a mycotroph (obtaining carbohydrates from soil fungi). Although its perennating buds are born on a rhizome, the growth habit of *Cyfa* is not like that of typical rhizomatous forbs which spread widely and produce ramets at numerous nodes on an extensive rhizome system. The rhizome of *Cyfa* is short, and elongates little between annual buds. New shoots are produced only from the terminus of this rhizome, although the roots associated with previous buds remain functional. Plants can go 2 or more years without producing aerial stems, during which time they function as mycotrophs.

The underground morphology of *Cyfa* is of particular interest for determining:

- susceptibility to physical disturbance and fire,
- tendency to produced multiple ramets from the same genet, and
- age of a plant.

Although shoot buds are only produced at the terminus of the rhizome, several shoots can be produced in a given year (Aagaard et al. 1999, Latham and Hibbs 2001). These generally emerge from the soil within 2.5 cm (1 inch) of one another. In a study of the relationship of distance between stems and their genetic distance, clonal stems were not found at a distance greater than 8 cm from each other (Hollis et al. 2002). However, it was also possible to find stems from different genets within a few centimeters of each other. Multi-stemmed plants seem characteristic of certain habitats or populations. In moist-forest habitats, plants tend to produce only one or two stems. In dry forests, plants typically have numerous stems with as many as six being common. Stem number presumably reflects plant vigor, as abundant carbohydrate reserves would be needed. Stem number could be related to habitat or to genetics.

Harrod (pers. comm.) has observed various exceptions to this basic growth habit. He determined that the rhizome of *Cyfa* can branch, each branch then producing annual buds. He also observed tightly clustered rhizomes, not physically connected, that probably originated from separate seeds. In one instance, an adventitious bud was observed on a root (Harrod pers. comm.).

## GEOGRAPHICAL DISTRIBUTION

### Global range

*Cyfa* is found in portions of California, Oregon, Washington, Idaho, Montana, Wyoming, Colorado, and Utah (Appendix B, Map 1). It was once reported from southern British Columbia but apparently no longer occurs there or was incorrectly reported to occur there (Brownell and Catling 1987). It only inhabits a portion of each state of occurrence, exhibiting a patchy distribution, and is sparsely distributed in most of the areas in which it occurs.

### Northern Rocky Mountain range

In Idaho, *Cyfa* ranges from Kootenai County, south to the South Fork Clearwater River in Idaho County. An historical collection from Bonner County (Appendix B, Map 1) has not been located. In Montana, *Cyfa* occurs in Lake, Mineral, Sanders, and Missoula counties (Appendix B, Map 2).

### Precise occurrences

In Montana, known populations are organized into only about 31 element occurrences (EO), of which three are historical (i.e., early collections that were never relocated; Appendix C). Twenty-six of these were documented in the MTNHP database at the beginning of this project, and five were added from Forest Service records. Many Montana occurrences are large and extensive (e.g., 007 extends into six sections), and some have relatively high plant densities (e.g., 021 with 2000 stems in 2 acres). The IDCDC database (IDCDC 2002) contained 115 EOs of which seven were historical (not observed since prior to 1980). Canfield Butte near Coeur d'Alene will be the 116<sup>th</sup> record. Most Idaho occurrences are small (fewer than 10 plants).

Selected information from each element occurrence record (EOR) is tabled in Appendix C. Population size is given a rank that reflects as closely as possible the number of genets observed. The habitat type series is often a part of the record, but where it was not, it was inferred if possible from the list of associated species. Selected comments are included relating to stand history, number of subpopulations ("groups"), and monitoring plots. For occurrences comprised of separate groups of plants, the "size" (areal extent), may be misleading as it reflects strictly occupied habitat (sum of all areas occupied by all groups).

### Land ownership and existing protection

Of 146 *Cyfa* occurrences in the northern Rocky Mountains<sup>1</sup>, 126 are on, or partially on, lands managed by the U.S. Forest Service (Appendix C). The remaining occur on lands managed by other federal agencies, states, and private entities. *Cyfa* is not extensive on these other ownerships. Only about five occurrences, all small, are in protected areas (Aquarius and Lochsa Research Natural Areas, Clearwater National Forest, Idaho).

### Adequacy of inventory

The conservation status of rare plants is based primarily on species abundance. Our knowledge of the distribution and abundance of *Cyfa* has greatly expanded since 1990, with the requirement for botanical surveys during project planning. Most known populations, especially the largest ones, are within or partially within timber sale areas or areas slated for management actions such as thinning or prescribed burning. The following briefly describes the history of our knowledge of the taxon in Idaho and Montana.

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<sup>1</sup> 140 were in Natural Heritage databases as of September, 2002, others are designated "s.n." in Appendix C.

**Montana:** *Cyfa* was rediscovered in Montana in 1991. Prior to that time it was known only from very early herbarium specimens (MTNHP 2002). Twelve sites were reported in 1991-1992, nine of these on the Lolo National Forest, where most subsequent sites have been found. Most occurrences have been found and expanded as a result of clearance surveys for timber sales which are generally limited to cutting units and areas between units. Major metapopulations such as that in the Tamarack Creek drainage on the Lolo NF (MT 007 and MT 021) may be more extensive than is currently known.

**Idaho:** Only fifteen out of the current 116 occurrences were known prior to 1988. The number of Idaho sites increased steadily through the 90s as a result of clearance surveys, incidental observations during other botanical surveys, and an ecosystem-scale botanical survey conducted in the Clearwater basin in 1994 (Lichthardt and Moseley 1994). Idaho populations are mostly small and widely dispersed.

#### **Element Occurrence: definition**

Because this Conservation Strategy relies to a large extent on the element occurrence (EO) as a record-keeping and tracking device, a definition of an EO, as it relates to *Cyfa* is warranted. The NatureServe Network (NatureServe 2002) defines an EO as "an area of land and/or water in which a species or natural community is or was present." In practice, it is a geographic location within which all reported observations of a species are tracked by a single database record (Element Occurrence Record or EOR).

For *Cyfa*, an occurrence is currently defined as any group of plants separated by at least one mile from any other occurrence, or by distinct landscape features such as ridges or rivers. Element occurrence records are not currently organized into a metapopulation hierarchy but such organization is possible within the NHP/CDC data system and allows tracking of individual subpopulations.

*Cyfa* occurrences are organized somewhat differently between Idaho and Montana and because of this the number of EORs may not accurately represent the relative abundance of the species in the two states. In Montana, where *Cyfa* was not rediscovered until 1991, sightings have primarily resulted from thorough searches of large project areas, mostly related to environmental impact statements (EIS) for timber sales and prescribed burns. The resulting EORs represent metapopulations—some with numerous populations and large numbers of plants (e.g., MT 010, South Fork Little Joe). By contrast, early observations of *Cyfa* in the Clearwater basin of Idaho were mostly incidental and small, often limited to a single cluster of plants. Some of the EOs from this area could be combined and tracked as metapopulations.

### **HABITAT**

Habitats of *Cyfa* vary widely across its range, even within its northern Rocky Mountain range (USFS, Region 1), and are discussed below by region. However, a few general habitat requirements are applicable.

#### **Regional vegetation**

In northern Idaho, *Cyfa* occurs in forests of the *Thuja-Tsuga* zone (Daubenmire 1969), in a region of marked maritime influence. To the east of the Bitterroot divide, in Montana, the maritime influence is diminished, but forests in the *Thuja* and *Tsuga* series still occur at lower elevations.

In this drier region *Cyfa* most often occurs in drier forest types, primarily Douglas-fir habitat types.

### General habitat

In the northern Rocky Mountains, *Cyfa* is restricted to coniferous forest, or inclusions in coniferous forest, between 1,500 and 4,680 ft elevation, where it occurs on all aspects, and on slopes from 0 to 90% (IDCDC 2002; MTNHP 2002). Some level of shade is generally present, ranging from deep shade to partial shade or dappled sunlight. Like all orchids, *Cyfa* is mycorrhizal, meaning that its roots are colonized by hyphae of symbiotic soil fungi that are essential to its life cycle.

*Cyfa* is distributed along river canyons and in the breaklands of these rivers including footslopes and terraces. The overall landscape is one of steep slopes, dissected topography, and aspect-controlled vegetation. Forest structure and composition have largely resulted from past fires. In Montana, this influence occurred mostly during the 1910 fires and earlier. In Idaho, many areas burned in the 1930s as well. In the period from 1910 to present most of the range of the species in both states has been protected from wildfire.

It is possible that habitat requirements for *Cyfa* are quite general. The pollinator and endomycorrhizae required may be quite common. It grows in stands with historically short fire intervals and also occurs, although in less abundance, in stands with long fire intervals.

### Plant associations (habitat types)

*Cyfa* occurs in a landscape characterized by extreme topography and sharp aspect contrasts accompanied by rather intricate patterns of environmental variation, and the habitat type in occupied areas can be difficult to ascertain. Often, moist, western redcedar (*Thuja plicata*) forest of the river bottoms transitions quickly to dry forest upslope. Moist forests also occupy minor drainages and north slopes, often with grand fir (*Abies grandis*) on intermediate sites or in early seral stands of western redcedar habitat types (HT), creating an intricate pattern of communities and ecotones.

In Forest Service Region 1, *Cyfa* is primarily associated with the following habitat types and phases (listed in order from moist to dry). Habitat types for Idaho follow Cooper et al. (1991), and those for Montana, Pfister et al. (1977).

<i>Thuja plicata</i> / <i>Adiantum pedatum</i>	Western redcedar/maidenhair fern
<i>Thuja plicata</i> / <i>Asarum caudatum</i>	Western redcedar/wild ginger
<i>Thuja plicata</i> / <i>Clintonia uniflora</i>	Western redcedar/queencup beadlily
<i>Abies grandis</i> / <i>Clintonia uniflora</i>	Grand fir/queencup beadlily
<i>Abies grandis</i> / <i>Clintonia uniflora</i>	
– <i>Physocarpus malvaceus</i>	Grand fir/queencup beadlily–ninebark
<i>Abies grandis</i> / <i>Linnaea borealis</i>	Grand fir/twinflower
<i>Abies grandis</i> / <i>Physocarpus malvaceus</i>	Grand fir/ninebark
<i>Pseudotsuga menziesii</i> / <i>Physocarpus malvaceus</i>	Douglas-fir/ninebark
<i>Pseudotsuga menziesii</i> / <i>Physocarpus malvaceus</i>	
– <i>Calamagrostis rubescens</i>	Douglas-fir/ninebark–pinegrass

Rare occurrences are known in the subalpine fir (*Abies lasiocarpa*) series (Montana) and western hemlock (*Tsuga heterophylla*) series (ID 015).

### Seral status

The seral status of stands in which *Cyfa* occurs is not often indicated in the EOR. In Montana, it typically occurs in the Douglas-fir/ninebark (*Pseudotsuga menziesii*/*Physocarpus malvaceus*) habitat type, which experiences short fire intervals (10-30 yrs; Arno 1976) and is prone to disease. All seral stages tend to be dominated by the climax species, often with western larch (*Larix occidentalis*) and ponderosa pine (*Pinus ponderosa*) mixed in (Pfister et al. 1997). Stands tend to be multi-aged and stratified, with shrub understories. However, one of the largest Idaho populations occurs in a ponderosa pine cover type that has been maintained by fire (ID 094; Lake, pers. comm.). Descriptions of several stands on the Lolo NF that are part of large occurrences of *Cyfa* can be found in Appendix D.

In the moist-forest habitat types occupied by *Cyfa*, the primary seral species is grand fir. *Cyfa* often occurs in mid-seral stands dominated by grand fir or by a mixture of grand fir and western redcedar, but is most commonly associated with late-seral stands of western redcedar. Most Idaho *Cyfa* occurrences are in these moist-forest types.

### Habitat by region

**Clearwater basin** (Clearwater and Nez Perce National Forests): here *Cyfa* occurs in moist forests of the western hemlock and western redcedar series. Successional status ranges from mid-seral stands dominated by grand fir, to old-growth, including groves of remnant (> 4 ft dbh) western redcedar. In this region, *Cyfa* occurs with disjunct Pacific-coastal species such as Henderson's sedge (*Carex hendersonii*), western starflower (*Trientalis latifolia*), and Pacific dogwood (*Cornus nuttallii*) that are indicative of a humid, relatively mild subset of climatic conditions within this region. It occurs from 1,400-4,700 ft elevation where snowpack is light and disappears early. The most vigorous metapopulations are found on cooler aspects where western redcedar cover types are more extensive.

Notable exceptions to this characterization are the two sole occurrences on the South Fork Clearwater River (ID 031 and 094), which are south of the range of western redcedar and are widely disjunct from the nearest occurrences on the Selway River. *Cyfa* does not occur south of the Clearwater basin in Idaho.

**St. Joe River** (Idaho Panhandle National Forests): here *Cyfa* occurs in the western hemlock, western redcedar, and grand fir habitat type series.

**Coeur d'Alene River** (Idaho Panhandle National Forests): North of the St. Joe River, in the Coeur d'Alene drainage, *Cyfa* occupies grand fir and Douglas-fir habitat types. Here it has not yet been found in moist forest, which would be primarily western hemlock at this latitude. Plants appear no less vigorous in these dry habitat types, and possibly more so, exhibiting a pronounced tendency to be multi-stemmed.

**Bitterroot Mountains, Montana** (Lolo and Kootenai National Forests): *Cyfa* occurs primarily in Douglas-fir/ninebark and grand fir/ninebark habitat types at elevations from 2,600 to 4,680 ft (Greenlee 1977), on both north and south aspects. Many occurrences are associated with root-rot "pockets" where the fungi *Armillaria* spp. or *Phaeolus* spp. have killed Douglas-fir and created canopy gaps. *Armillaria* is a known orchid symbiont (Hadley 1982).

**Flathead Lake** (MT 023 and 024): two small, apparently isolated populations; habitat types are in the Douglas-fir series.

**Mission Mountains** (MT 004 and 005): two populations in western redcedar/beadlily habitat type.

#### Associated species

**Montana** (Primarily grand fir and Douglas-fir habitat types; Appendix B, Map 8)

Primary associated species by canopy layer are:

Trees: *Pseudotsuga menziesii* and *Pinus ponderosa*; and to much less extent, *Abies grandis*, *Larix occidentalis*, and *Thuja plicata*.

Shrubs: *Acer glabrum* (Rocky Mountain maple), *Amelanchier alnifolia* (serviceberry), *Ceanothus velutinus* (evergreen ceanothus), *Holodiscus discolor* (ocean spray), *Lonicera ciliosa* (trumpet honeysuckle), *Physocarpus malvaceus* (ninebark), *Rosa* spp., *Symphoricarpos albus* (snowberry), *Spiraea betulifolia* (birch-leaf spiraea), and *Vaccinium globulare* (globe huckleberry).

Low shrubs and herbs: *Adenocaulon bicolor* (trail plant), *Antennaria racemosa* (raceme pussytoes), *Apocynum androsaemifolium* (spreading dogbane), *Arctostaphylos uva-ursi* (bearberry), *Arnica* spp., *Balsamorhiza sagittata* (arrow-leaf balsamroot), *Berberis repens* (Oregon grape), *Calamagrostis rubescens* (pinegrass), *Carex geyeri* (Geyer's sedge), *Centaurea maculosa* (spotted knapweed), *Chimaphila umbellata* (prince's pine), *Corallorhiza* spp. (coral-root orchids), *Cypripedium montanum* (mountain lady's-slipper orchid), *Fragaria vesca* (strawberry), *Goodyera oblongifolia* (rattlesnake plantain), *Hieracium* spp. (hawkweeds), *Habenaria orbiculata* [= *Platanthera orbiculata*] (round-leaf rein orchid), *Linnaea borealis* (twinflower), *Listera* spp. (twayblade orchids), *Osmorhiza chilensis* (sweet cicely), *Polystichum munitum* (swordfern), *Pterospora andromedea* (pinedrops), *Sedum stenopetalum* (wormleaf stonecrop), *Smilacina stellata* [= *Maianthemum stellatum*] (starry Solomon's seal), *Viola* spp. (violets), and *Xerophyllum tenax* (beargrass).

*Cyfa* is often associated with other orchids and mycotrophic species.

**Idaho** (Primarily the western redcedar HT; Appendix B, Maps 6 and 7)

In the Clearwater basin, known populations of *Cyfa* are associated with an understory species assemblage typical of moist, western redcedar habitat types, and with coastal-disjunct species such as *Carex hendersonii* and *Trientalis latifolia*. The only common orchid is *Goodyera oblongifolia* (rattlesnake plantain) and other mycotrophic plants are scarce.

In the Coeur d'Alene drainage to the north, *Cyfa* is found in dry forest habitats with species associates similar to those in Montana, which often include other orchids and mycotrophic species. *Holodiscus discolor* (ocean spray) is a common associate. *Piperia elegans* (elegant rein-orchid) is an additional orchid found on some sites.

#### Edaphic factors

*Cyfa* occurs on substrates derived from a wide variety of parent materials including basalt, granite, gneiss, schists, metasediments, and alluvium. It is almost always associated with forest floor layers of litter and duff, less often with moss, and sometimes grows among rock talus. Average depth of the duff layer in Douglas-fir habitat types is 1-2.5 inches. The most important

feature of the substrate may be the presence of an organically enriched O horizon that provides habitat for mycorrhizal fungi.

### **Dependence on natural disturbance**

**Fire.** Stand structure and landscape pattern in regions where *Cyfa* occurs in Idaho and Montana have historically been determined by fire. In Montana, *Cyfa* occurs primarily in Douglas-fir/ninebark and grand fir/ninebark habitat types that historically experienced low to moderate intensity surface fires on an interval of 10 to 30 years (Arno 1976; Greenlee 1997). Following 50 or more years of fire suppression, stands in these habitat types are now more densely stocked and have greater canopy closure, increasing the probability of severe stand-replacement fires that could reduce the availability of suitable habitat, both in terms of canopy removal and adverse soil and ground-layer effects.

In the Clearwater basin of Idaho and the Swan Valley of Montana, *Cyfa* occurs in moist, western redcedar forests for which the mean interval for underburns was 75-100 years and for stand replacing fires, 150 to >200 years (Barrett 1993). Stand structure in these types may still be within the range of natural variability.

**Pathogens.** In Douglas-fir habitat types there is a possible association of *Cyfa* with root-rot pockets caused by the fungi *Armillaria* and *Phaeolus*. *Armillaria* sp. is a known orchid symbiont (Hadley 1982). This association has not been noted in moist-forest habitats where *Armillaria* is actually more common.

## **LIFE HISTORY**

At the lowest elevations (<2,000 ft), *Cyfa* flowers in late-April to mid-May, and at higher elevations in July, probably depending on soil warming. Flowering stems can produce 1-7 capsules, each of which contains thousands of seeds the size of dust particles (Harrod 1994).

### **Germination and development**

The following account is adapted from a description of the life history of *Cypripedium* species by Rasmussen (1995):

Orchid seeds have no endosperm and rely for nutrition upon infection by a mycorrhizal fungus. Germination technically begins with the imbibing of water by the seed, but this may be stimulated by the infection. In order for germination to be successful, most orchids require the presence of specific fungi in the developing embryo (Currah et al. 1988).

The germinating seed develops into an undifferentiated mass, or *protocorm*, from which the first roots will develop. The first root is densely infected with fungal pelotons. Later roots are progressively less infected, and by the fifth, the roots lack pelotons.

The protocorm elongates into a rhizome during the second year. The first above-ground shoot appears in the second, third, or fourth spring in *Cyfa* as well as other *Cypripedium* species (Cribb 1997). The first shoot is small and vegetative (Latham, pers. comm.). Vegetative shoots simply have a terminal pair of leaves. Later shoots may be vegetative or reproductive.

The rhizome elongates during the growth season, producing a new root in each successive year as the posterior end of the rhizome dies. One or more buds containing the leaves and inflorescence

for the following year develop at the terminus of the rhizome during the summer. The next-year's shoot lies with its tip at or just below the soil surface, and growth commences as the soil warms in early spring.

### **Pollination**

Floral morphology, allozyme data, and pollinator exclusion studies support the conclusion that *Cyfa* is primarily outcrossing (Harrod and Knecht 1994, Aagaard et al. 1999, Lipow et al. 2002). Plants are self-compatible, but an insect vector is required. Studies of *Cyfa* pollination in southwestern Oregon, Colorado, and Idaho implicate a common Diapriid wasp in the genus *Cinetus* (Ferguson 2000, Lipow et al. 2002). It is a small wasp (<5 mm; 0.2 inches). Its larvae are parasitic on fungus gnats and the adults are found in forests where there is decaying vegetation and fungi. *Cinetus* is a common wasp that could occur throughout the species' range. The family Diapriidae is a large family with many undescribed species.

*Cyfa*, like many other orchid species, offers no apparent reward to its pollinators. Yet fruit set is relatively high for a non-rewarding species. In one study, the number of flowers setting fruit varied from 18 to 68% and was significantly different among populations (Lipow et al. 2002). Floral odor is currently being evaluated as a possible pollinator cue. Some researchers working with the plant have noticed a distinctive odor described variously as "musky" and "reminiscent of a barnyard odor with a citric component" (Ferguson 2000).

Evidence from several studies indicates that insect pollinators of *Cyfa* influence seed production. A lack of pollinators or low pollinator activity, such as under adverse weather conditions or after fire, results in low fruit-set (Knecht 1996, Ferguson 2000, Mantas, pers. comm.).

### **Seed dispersal**

Seeds mature three to four months after pollination and disperse through slits in the capsule that develop as it dries out. Seeds are dispersed over short distances by light air currents in the understory, and over longer distances by wind. Another potential agent of dispersal is by water movement during overland flow (Hollis et al. 2002). Due to inhibited air circulation in the forest understory, seeds were found to disperse up to only about 2 m from the parent plant (Harrod and Everett 1993), possibly explaining the organization of *Cyfa* plants into clusters.

### **Symbiosis**

In nature, orchids grow and survive only as part of a symbiotic association with mycorrhizal fungi. In order for germination to be successful, most orchids require the presence of specific mycorrhizal fungi in protocorm tissue (Currah et al. 1988). Fungal symbionts play a major role in the nutrition and competitive abilities of seedlings and mature plants (Hadley 1982). It is extremely difficult to identify mycorrhizal fungi and to establish which are part of the symbiosis. Over 40 species of fungi have been isolated from the roots of a single *Cyfa* plant, yet samples from three different populations had only three species of fungi in common (Latham, pers. comm.).

### **Dormancy**

Dormancy, or nonemergence, is common in *Cyfa*, even in undisturbed conditions. In a western redcedar/wild ginger habitat type *Cyfa* plants were never dormant for more than two years, over nine consecutive years of monitoring (Lichthardt 2000). In Oregon, plants commonly go as many

as 3 years without producing above-ground growth (Latham, pers. comm.). Plants that were reproductive in a previous year can return as vegetative shoots.

## METAPOPULATION STRUCTURE

*Cyfa* is distributed sparsely over the landscape, typically in very small, distinct clusters ("groups") or as individual plants. A population, as it is generally referred to, consists of one to numerous plant clusters in the same general area making clusters the equivalent of subpopulations. A dense population might consist of only 10 to 20 clusters in 160 acres. The extents and densities of known populations are often dependent on the level and extent of survey. A population may be restricted to a single stand or to a minor drainage. Metapopulations are comprised of numerous clusters of plants across different stands that may be separated by unsuitable habitat. Some clusters are aggregated into populations and others are isolated. The metapopulation can be quite large and difficult to define. The MTNHP and IDCDC track metapopulations of *Cyfa* as occurrences where possible. Guidelines specify that plants within 1 mile of each other be entered as the same EO. However, if sightings are rare in the landscape they may be entered separately. Database capabilities are expanding to allow tracking of occurrences within metapopulations and subpopulations within occurrences.

An explicit terminology can aid in discussing and tracking rare plant occurrences and will be useful in carrying out this Conservation Strategy. I am suggesting the following hierarchy of terms for describing metapopulation structure of *Cyfa*. The following definitions have not been drawn from any particular source, but seem consistent with terminology used by field botanists and the way in which the species is tracked by the MTNHP and IDCDC. For *Cyfa*, an element occurrence is generally equivalent to a population or a metapopulation.

1. *Sub-range*: a center of distribution within the species' northern Rocky Mountain range, for example, the St. Joe River, Bitterroot Mountains, Lochsa/Selway, Mission Mountains. (These have not been formally defined.)
2. *Metapopulation*: An aggregation of populations or of populations and individual clusters in the landscape; includes patches of unoccupied habitat and non-habitat but no major barriers such as high ridges, or major changes in habitat availability. Sometimes equivalent to an occurrence as tracked by the NHP/CDC network.
3. *Population*: one to numerous, generally very small, subpopulations (= clusters). The extent is usually on the scale of one to three stand polygons. Habitat is usually variable across large populations. Many populations consist of a single cluster of plants, reflecting the sparse distribution of the species in some areas.
4. *Subpopulations*: often referred to as *groups* (Appendix C) or *clusters*; individuals occurring in a small area (usually less than 0.1 ac), but apparently not originating from the same rhizome. Although the distinction between populations and metapopulations is subjective, clusters (subpopulations) tend to be fairly distinct. A subpopulation may consist of a single plant.
5. *Genet*: A genetic individual; all stems arising from the same rhizome (or appearing to ).

It has been noted that stems arising together ("clumped") are not always physically connected. However, they are likely very similar genetically and equally subject to microsite effects, so I

suggest they may effectively be viewed as a genet. Many field botanists appear to identify *Cyfa* genets in this way with a high level of confidence. In moist-forest habitat this is not problematic as plants usually grow as single stems.

## GENETIC VARIATION

The way in which genetic variation is partitioned among plant clusters, populations, metapopulations, and local ranges is relevant to many aspects of the conservation of *Cyfa*. Patterns of variation can be used to interpret the evolutionary and biogeographic history of the taxon and are indicative of the breeding system, which relates to the importance of pollinators and potential for genetic drift. Populations sampled in several of the disjunct ranges of *Cyfa* show that within-population genetic variation is well structured, and of sufficient magnitude to avoid genetic drift. This indicates that pollen and seeds are well dispersed within populations (Hollis et al. 2002). These results are compatible with those of Agaard et al. (1999) who sampled three populations in the Wenatchee Mountains of central Washington and found that only a small amount of the genetic variation observed was due to differentiation among populations, with much of the allelic diversity contained within local populations. These populations were said to be geographically close and likely would correspond to subpopulations by our definition. Plants within the same cluster were found to be genetically homogeneous. (Here they may be referring to stems in a clump.) However, isolated populations have little chance of gene flow, resulting in a greater potential for drift.

## DEMOGRAPHY

*Cyfa* genets are long-lived; spend prolonged periods, including the seedling stage, as strictly mycotrophic; and require at least 3 years to reach reproductive maturity. Although genetic individuals can probably be estimated with some accuracy, *Cyfa* does not have easily discernable life stages. The status (vegetative/reproductive/dormant) of an individual may be related to environmental conditions or to the previous year's reproductive output (Primack et al. 1994). A very small, vegetative individual was found to be 7 years old, based on the number of bud scars on the rhizome (Mantas pers. comm.).

Latham and Hibbs (2001) defined five developmental classes for *Cyfa* based on leaf length and reproductive status (Table 2). By excavating and aging 30 plants they found that there was some correlation between plant age and leaf area.

In a western redcedar/wild ginger habitat type, over nine consecutive years of monitoring, one of the 6-8 original plants, died and three new plants were recruited (Lichthardt 2000). During the first six years, only one plant out of eight produced more than a single stem. In later years, double stems became slightly more common but only once did a plant produce three stems.

Population size is an important indicator of population vigor and viability, and may be used as an index of habitat quality and conservation status. It must be remembered however, that population size is related to both current conditions and past processes. Abundance ranks for *Cyfa* occurrences in Region 1 are shown in Appendix C, and indicated on Maps 3-5 in Appendix B. An abundance rank was assigned based on the number of plants (genets) in the occurrence (A = >200; B = 50-200; C = 10-50; D = <10). These ranks should not be interpreted as indicating conservation priority, which is based on additional parameters. It should also be noted that ranks are dependent to some degree on the extent of survey and on the way in which sightings are organized into occurrences.

Table 2. Size/stage classes developed for demographic monitoring of *Cypripedium fasciculatum* (Latham and Hibbs 2001).

Class	Description
1	Flowering stem, >100 mm total leaf length
2	Non-flowering stem, >100 mm total leaf length
3	Non-flowering stem, 41-100 mm total leaf length*
4	Non-flowering stem, 31-40 mm total leaf length
5	Non-flowering stem, <31 mm total leaf length

\* Stems in this size class may occasionally develop flowers, but this occurs a low percentage of the time. The proportion of Class 3 flowering plants is currently being quantified and analyzed.

The number of plants in evidence varies greatly from year to year, mostly as a result of non-emergence, which can extend for at least three years (Latham, pers. comm.). The number of genets, even if an estimate, is a more useful parameter of a population's viability, resilience to disturbance, and potential genetic variation, than numbers of stems. Stem numbers fluctuate even more widely than genets, and stems growing in the same clump are very similar genetically, if not identical (Aagaard et al. 1999). While rhizomes from separate individuals can lie in close contact (Harrod pers. comm.), stems as much as 3 cm apart can be attached to the same rhizome (Latham, pers. comm.; Harrod et al. 2001).

Population size within three contrasting sub-ranges is discussed below:

**Lochsa/Selway canyons, Idaho:** Subpopulations are very small (1-50 individuals) and widely scattered. A particularly large population at the mouth of the Selway River has about 100 plants over 160 acres (ID 043). A particularly dense subpopulation, also on the Selway, has 50 plants in 100 yd<sup>2</sup> (ID 021). The largest populations are found on cooler aspects where western redcedar cover types are more extensive.

**St. Joe River, Idaho:** Several large metapopulations occur in tributary canyons of the St. Joe River (013 and 087). Some subpopulations are relatively dense (e.g., 10 plants in 20 yd<sup>2</sup>), and the individual plants are vigorous with typically more than three stems per plant.

**Bitterroot Mountains, Montana:** Metapopulations consist of numerous populations of various size over extensive areas. Some populations are both extensive and dense. Montana #021 includes one of the highest density populations known, with more than 2000 stems in 1 acre.

## RESPONSE TO DISTURBANCE

Disturbances of primary concern include fire, various types of timber harvest, thinning, and ground disturbance associated with these activities. The following discussion addresses canopy removal (logging/canopy fires), wildfire, and prescribed underburns.

### Canopy removal

Most observers assume that *Cyfa* is adversely affected by a certain level of overstory removal. For several years after a blowdown, only two plants from an original population of 58 could be found (Greenlee 1997). Knecht (1996), working in the Cascade Range advised against any management activity that would reduce the canopy closure below 60%. The critical factor is probably evapotranspiration. Plants growing in open situations tend to senesce earlier than plants in more shaded conditions (Vance and Lake 2001; Lavelle, pers. comm.) thus preventing fruit set and limiting carbohydrate storage.

The effect of overstory removal can be mitigated at least somewhat by shrub cover, adjacent forest, or even tall forbs. In a western redcedar/maidenhair fern habitat type, 81 flowering genets were recorded within a burned area 5 years after a variable-intensity wildfire (ID 046). The tree canopy was gone and the plants were growing under a dense cover of fireweed (*Epilobium angustifolium*). Vance and Lake (2001) speculated that shrub cover was responsible for survival of *Cyfa* after a shelter-wood cut.

A monitoring plot on the Lolo NF may eventually show the effects of maintaining *Cyfa* in tree "islands" (Table 3). The plot is in a unit that was thinned in spring, 1997, but no trees within or adjacent to the plot were harvested (Lavelle, pers. comm.). Although the plot is in a Douglas-fir/ninebark HT, there is little or no shrub cover in the plot. The number of *Cyfa* stems present has varied by as much as 80% between two consecutive years, making it difficult to draw conclusions from the low stem numbers in the two most recent years. These data point out the importance of long-term monitoring.

Table 3. Number of *Cypripedium fasciculatum* stems in a monitoring plot within a thinning project (no cutting within or adjacent to plot; EOR MT 019). Source: Lolo National Forest.

Year	Number of stems				
	1996	1997	1998	2000	2002
	46	8	46	23	17
Percentage of stems flowering					
	50	62	26	22	12

### Fire

The response of *Cyfa* to fire is an important consideration of this CS because of the many large and small prescribed burning projects planned in its habitat. In the short term, *Cyfa* is sensitive to both direct and indirect effects of fire. Removal of aerial stems decreases the plant's ability to store nutrients and can interfere with seed production. On the Lolo National Forest, a spring underburn that singed plants did not prevent their continued growth. A season of vegetative growth may be required to restore carbohydrate reserves needed for flowering (Vance and Lake 2001). In Knecht's (1996) study a ground fire decreased the abundance of *Cyfa* pollinators and thus fruit-set for at least the first post-fire year.

Observers generally agree that the rhizome of *Cyfa* is shallow (1-5 inches below the mineral soil surface), but opinions differ as to how much protection this affords. Working in southwestern Oregon, Latham (pers. comm.) found that the rhizomes of most plants were at least 2 inches

below mineral soil and speculated that this would protect them from the direct effects of fire. Seevers and Lang (1998) felt that intense fire could damage rhizomes as deep as 5 inches.

Evidence of the direct effects of fire on *Cyfa* is conflicting. This should not be surprising, as fires are variable in intensity and pattern. The heat, intensity, and duration are dependent on numerous factors including site, depth and nature of litter, understory vegetation, downed woody debris, and weather. Also, affected plants may remain dormant for several years. Knecht (1996) and Harrod et al. (1997) found that *Cyfa* cannot tolerate a low-intensity fire if it consumes the duff layer and they attributed this effect to the plant's shallow rhizome. This is also supported by observations made by Shelly (pers. comm.) following the Flat Fire near Superior, Montana.

### Monitoring results

Monitoring that began 5 years ago is just now providing some evidence of the effects of natural and prescribed fire on mortality. No longer term data are available.

On the Nez Perce National Forest, a portion of a population affected by a shelterwood cut and spring broadcast burning was monitored for 3 years (Vance and Lake 2001). The habitat type is Douglas-fir/ninebark. The treatment was characterized as partial overstory removal and low-intensity burn. In the year following the fire, only 1 out of 100 total plants flowered in the burned plots, probably because existing carbohydrate reserves were allocated to vegetative growth. Numbers of plants increased each year, over the first three post-fire years, in both burned and unburned treatments. Capsule production was lower in the burned plots each year, possibly due to loss of cover resulting from the shelterwood cut and fire.

Harrod et al. (1997) measured changes in population size and morphology of *Cyfa* following a creeping groundfire that burned some plants and not others. In locations where the duff layer had been eliminated by fire, plants were killed. The number of aerial stems increased in all plots in the second year, despite the fact that there were four fewer clusters of stems at the burned site. The number of plants with fruits decreased by 33% at the burned site but by no more than 4% at unburned sites. There was a significant decrease in the number of fruits per stem at the burned site only. There were no significant differences following the fire in parameters of plant vigor (flowers/stem, plant height, leaf width, leaf length). Three years after the fire, seedlings appeared in a plot where litter and duff had been eliminated and *Cyfa* plants killed (Harrod et al. 2001).

The Lolo NF currently has 20 monitoring plots for *Cyfa* in thin and/or underburn units, including two control plots. The first units were harvested prior to the 1997 growing season. Plots have been monitored for 6 years after a seed-tree harvest in a Douglas-fir/ninebark HT, followed by moderate (0-50% duff removal) and severe (50-100% duff removal) spring underburns (Table 4; Lavelle, pers. comm.). Control and moderate burn plots had shrub cover, but there was no shrub cover in the severe burn. There were no *Cyfa* plants in the severe burn for the first two growing seasons. Five years later, there were 11 stems out of an original 37. Plants were found growing under the cover of forbs and shrubs and appeared to be survivors as opposed to new recruits. In the moderate burn, stem numbers have exceeded the baseline data in all but the first post-fire year. From the data we cannot tell how much of the change is due to increased ramet production, emergence of previously dormant plants, or new recruitment, but observers indicated new plants were in approximately the pre-burn locations. Fluctuations in stem numbers in the control plot show the importance of continued monitoring.

Table 4. Effect of seed-tree harvest (spring, 1997) followed by moderate and severe underburns (spring, 1998), on *Cypripedium fasciculatum* stem numbers in a Douglas-fir/ninebark HT. (EOR MT 014). Source: Lolo National Forest.

Year	Number of stems					
	1997	1998	1999	2000	2001	2002
Control	81	100	37	160	63	122
Moderate	78	54	81	93	85	111
Severe	37	0	0	3	10	11

### Soil disturbance

Rhizomes of *Cyfa* are shallow and fragile. They do not even survive careful excavation. The shallow rhizome system of *Cyfa* makes it susceptible to physical disturbance during management projects and fire suppression activities.

## THREATS

Research and field observations indicate the primary threats to survival of *Cyfa* are those that result in overstory removal or soil disturbance. Plants can also be killed by underburns, but these are less likely to eliminate entire populations. Based on observations made in the Cascade Mountains, Knecht (1996) thought that reducing tree canopy cover to less than 60% would be deleterious to population vigor. Because of its shallow rhizomes, *Cyfa* is likely susceptible to physical disturbance caused by timber projects or fire suppression activities. Minor leaf herbivory is common, but does not appear significant. Collection and trampling of plants at campgrounds and along trails is a serious but mostly localized threat. Exotic weeds are uncommon in *Cyfa* habitat. Where they do occur, they are patchy and associated with soil disturbance and roads. Road and trail building and slash pile burning are vectors of weed movement into *Cyfa* habitat.

## CONSERVATION STRATEGY

### Goals

The overarching goal of this Conservation Strategy is to maintain *Cyfa* within viable metapopulations throughout its range in Region 1. On a local scale, this requires the maintenance of well-distributed populations in metapopulation areas where they currently exist, and providing for both current and future suitable habitat within the metapopulation area.

### Issues

In general, Forest Botanists need to 1) assess the conservation status of *Cyfa* within their management units, 2) look for opportunities where judicious use of prescribed fire and silvicultural treatments can be used to restore or improve habitat conditions, 3) assess the effects of Forest projects on viability of local populations, and 4) provide guidelines for the mitigation of project effects. Potential management needs include prescribed burning, to bring fuel loads to

more natural levels, and weed control. Projects commonly affecting *Cyfa* on a population or metapopulation scale include road construction, various types of timber harvest, stand thinning, prescribed fire, mechanical fuels treatment, and herbicide spraying.

### Management considerations

The following generalizations arise from previous sections on the habitat and ecology of *Cyfa* and are related to its response to management actions.

**Seral stage.** It is very likely that *Cyfa* increases in numbers and distribution with increasing stand age and development, and, as suggested by Harrod (pers. comm.), may be thriving in some areas under conditions of fire suppression. As stands age they become patchy and multilayered, allowing more light to the forest floor and building up deeper duff layers and rotted wood that provides a medium for a rich fungal network.

**Fire regime.** In dry-forest habitat, *Cyfa* occurs in stands that are multi-aged, with remnant large trees often present (Appendix D). Historically, these stands burned frequently in wildfires of variable intensity. Many stands in these habitat types may be outside the range of natural variability and prone to severe, stand-replacement fires. These situations present opportunities where prescribed fire and silvicultural practices might be used to restore or improve habitat conditions.

In moist-forest habitat, where plants are associated with partial to deep shade, *Cyfa* may be adapted to a longer fire interval. Following a stand-replacing fire, long time periods may be required for recolonization by plants surviving in shaded refugia of drainage bottoms.

**Canopy opening.** *Cyfa* requires some level of shade. Sixty-percent tree canopy cover has been recommended as a minimum level by researchers working in the Cascade Mountains (Knecht 1996). Increased solar radiation causes early senescence, curtails seed production, and, in excessive amounts, will apparently kill plants. However, in dry forests, many *Cyfa* sites have much less than 60% tree cover (Applegate, pers. comm.) and it can apparently persist under a tree cover less than 30% (Lavelle, pers. comm.). Shrub cover may be important under these conditions. Nothing is known about the ability of seedlings to establish under these levels of radiation.

**Fire.** The shallow rhizome of *Cyfa* makes it susceptible to a ground fire that is hot enough to consume the duff layer (Knecht 1996; Harrod et al. 1997; Shelly, pers. comm.). However, it seems resilient to fires of light and moderate severity that leave some duff.

**Patch size.** Increased solar radiation can also result from opening the canopy adjacent to *Cyfa*-occupied habitat and creating a forest edge. In situations where occupied habitat is to be excluded from management, the question arises as to how much buffer should be allowed around the population. If habitat conditions are to remain relatively constant, it should be large enough that the population is not within the zone of edge effects. The width of this zone is dependent to some extent on edge physiognomy (forest structure) but primarily on aspect (Chen et al. 1995), with the widest zone on south-facing edges.

When determining patch size for protecting *Cyfa*, connectivity between subpopulations, opportunities for expansion of the population, and the potential existence of non-emergent plants should also be considered. Due to the sparse distribution of *Cyfa*, densities as high as 10

clusters per 40 acres are rare, and large patch sizes will be required to protect a number of clusters (subpopulations).

**Seed source populations.** In moist forests, the distribution of *Cyfa* is aggregated along stream courses, including intermittent streams, where fires burned less hot and left more forest cover. Stream courses may have served as refugia from which plants spread as forest regenerated in adjoining burned areas. This does not appear to be the case in dry forest types where plants may have survived in forested islands or under cover of shrubs. In order to ensure metapopulation viability, management of stands with *Cyfa*, in both moist and dry forest types, should be limited to areas where plants are well-distributed and where vigorous populations can be identified and protected as seed sources.

**Maintenance of genetic diversity.** Aagaard et al. (1999) found a low level of genetic differentiation among local (geographically proximal) populations, which likely corresponded to subpopulations by our definition. Given this, it is important to maintain habitat continuity among populations. One objective of management should be to maximize habitat continuity within populations in order to facilitate gene flow and provide opportunities for expansion. Populations consisting of many closely aggregated subpopulations will be most resistant to genetic drift and are of the highest conservation priority.

**Woody residue** is important to maintaining soil organic matter, microorganisms, and mycorrhizal fungi. Some level of standing-dead and downed trees must be maintained following salvage or harvest operations in order to manage for an optimum soil environment for mycotrophic species such as *Cyfa*, as well as regenerating trees.

**Soil disturbance.** The shallow rhizome system of *Cyfa* makes it susceptible to physical disturbance during management projects and fire suppression activities. With regard to forest management in *Cyfa* habitat, Seevers and Lang (1998) state: "Avoid activities that alter soil, duff, down wood, and the mycorrhizal community in the habitat area."

**Fungal symbionts.** Effects of burning and/or logging on mycorrhizal fungi are complex, but it appears that these activities influence diversity and species composition more than simple abundance (Borchers and Perry 1990). We still have no knowledge of the degree to which mycorrhizal fungi may limit the distribution and establishment of *Cyfa*. However, we can manage for soil conditions conducive to a diverse soil microbiota, including maintaining logs of various decay classes, minimizing physical soil disturbance, and providing for recruitment of large woody debris.

## Definitions

**Abundance rank:** Abundance ranks are based on the estimated number of genets in the occurrence: A (>200), B (50-200), C (10-50), and D (<10). These are indicated in Appendix C and in Appendix B, maps 3-5.

**Priority occurrences for protection:** These are primarily peripheral or isolated relative to the regional distribution of the species or to other occurrences within the administrative unit. Occurrence size (number of genets) is not really a consideration. Larger, well-structured metapopulations may actually warrant less protection. Small (C and D-ranked), apparently isolated occurrences might not be considered viable, but may represent the only seed source for a large area and are usually easily protected. These smaller occurrences are also important for maintaining geographic distribution at National Forest and higher scales.

Small, peripheral occurrences such as Canfield Butte on the Fernan District, Idaho Panhandle NFs, should be considered high conservation priorities. They could too easily be lost from a combination of human disturbance and natural events. Such peripheral populations, especially in variant habitat, may contain important genetic diversity. Prescribed burns and fuels reduction in adjacent stands may benefit the orchid by decreasing the risk of a hot burn, but precautions must be taken to protect these populations from project impacts.

Other peripheral and isolated occurrences with high conservation priority include: Piper Creek (MT 005), Granite Creek/Fall Creek (ID 094 and 031), and Mannering Creek (ID 015).

**Seed-source populations:** In large metapopulations where management is planned, priority populations should be identified based on a high density of subpopulations (e.g., 5-10 per 80 acres). If individual clusters are lost or diminished as a result of management, these populations, along with any protected in stream buffers, can provide seed sources for recolonization or avenues for gene flow. Seed-source populations can be selected for a combination of plant density and potential for protection.

**Metapopulation:** As used here, refers to an aggregation of populations within the landscape, on a scale smaller than a 6<sup>th</sup> field watershed—usually just a portion of such a watershed—and often confined to a 3<sup>rd</sup> or 4<sup>th</sup>-order drainage. Some of the larger known metapopulations have been fairly well-defined by extensive survey. There may be many scattered outliers between metapopulations. Where clusters are widely scattered, landscape features such as ridges and rivers might be used to delineate metapopulations.

### Approach

The approach of this Conservation Strategy relies heavily on abundance rank (A to D; Appendix C) as an indicator of metapopulation vigor and habitat quality. Viability of the metapopulation is also related to the number and density of subpopulations, threats, habitat fragmentation, and other unknown factors. However, A-ranked occurrences tend to be well structured, with numerous subpopulations separated by distances of less than 0.5 mile, and thus more resilient to disturbance than small, isolated occurrences. This approach allows more latitude in management within the more vigorous and resilient occurrences. A drawback to this approach is that abundance ranks are partially the result of the extent of survey and the way in which occurrences have been delineated. To effectively use this approach it may be necessary to review occurrence records and evaluate whether their organization is consistent across the Forest and whether abundance ranks accurately reflect metapopulation vigor (e.g., also consider habitat continuity and disturbance).

The approach outlined below utilizes abundance and degree of isolation to determine the level of protection required, particularly when some type of forest management is desired.

1. Use the known Region 1 distribution of occurrences (Appendix B, Maps 3-5) to identify peripheral and outlying occurrences that will have a high priority for protection and monitoring. (See definition in preceding section.)
2. Use local distribution and abundance data to identify priority occurrences for protection and monitoring by district.

3. For A- and B-ranked occurrences:

- a) Evaluate habitat and identify any opportunities where prescribed fire or silvicultural practices might be used to restore or improve habitat conditions.
- b) Evaluate the need for monitoring, changes to data organization (the way in which sightings are grouped into occurrences), or additional survey.
- c) For management activities within A and B-ranked occurrences (metapopulations):
  - i) Review project design considerations below during development of a site-specific management prescription.
  - ii) Designate protected seed-source populations (see definition above)
  - iii) Establish monitoring

4. For C- and D-ranked occurrences:

- a) Identify areas for additional survey based on the known distribution of *Cyfa* and potential habitat.
- b) Consider whether occurrence is part of a larger metapopulation. Consider continuity of habitat and distance to nearest known occurrence, with 0.5 mi as a possible criterion for separation.
- c) Within project areas where significant canopy reduction is planned: protect within large patches (40-acre optimum) where possible, allowing a forested buffer that will minimize edge effects.

**Project design considerations**

The following elements should be considered when developing a project design compatible with long-term viability of *Cyfa*. These elements are related specifically to timber harvest and prescribed burns, and may not be applicable to other types of projects. These relate only to A- and B-ranked occurrences (metapopulations).

- Seed-source populations. These should be protected from the direct and indirect affects of management. Populations consisting of numerous, closely aggregated clusters are of the highest conservation priority within the metapopulation area.
- Buffers. Buffers should follow a design that incorporates the pattern of subpopulations to be protected, suitable habitat, and landscape features.
- Seral stage. Within the metapopulation area, large tracts of forest in mid to late seral stage should be maintained. Generally this means the dominate species is the climax species (or potential natural vegetation) and the dominate size class is greater than 9 inches dbh.
- Fire pattern. Management should emulate a natural landscape pattern created by fires of variable intensity.

- Fire severity/intensity. Low severity/intensity fire is least likely to kill rhizomes or consume the duff layer.
- Decayed down logs and duff layer. These should be maintained within the area of the occurrence (both occupied and unoccupied habitat) appropriate to the habitat type(s).
- Future recruitment of coarse woody debris.
- Harvest type. Shelterwood and selective cuts can be used in portions of A- and B-ranked occurrences, retaining tree canopy cover appropriate to the species' habitat within the forest type (dry vs. moist).
- Ground disturbance. Ground and soil disturbance should be minimized during management activities in suitable and occupied habitat.
- Weeds. Certain activities such as prescribed fire, timber harvest and recreation may increase weed spread. Treat noxious weed infestations that may threaten *Cyfa* and provide mitigation measures to reduce weed spread during management activities.
- Documentation. All prescriptive elements connected to *Cyfa* conservation should be documented in the silvicultural prescription and burn plan.
- Monitoring. Baseline and post-treatment data from permanent plots will allow adaptive management.

### Target landscape

The goal of maintaining "well-distributed populations throughout the range of the species in Region 1" infers that some loss of subpopulations is expected, but that forests will be managed within the range of historical variability, so opportunities for colonization of new habitat will be available.

A-ranked metapopulations with a high level of survey provide target subpopulation density and distribution in the two different forest habitats. Densities are much lower for moist-forest types. Where timber management or harvest is desired, the target for such metapopulations should be to maximize habitat continuity between populations and maintain large patches of late-seral forest. Management within the metapopulation area involves the maintenance of both occupied and unoccupied habitat. In dry forests (Douglas-fir series) more open tree canopy is tolerated, but a range in seral stages should be represented at the scale of the 6<sup>th</sup> field watershed.

## RECOMMENDATIONS

### Conservation status

*Cyfa* should be retained as a sensitive species in Region 1. Without sensitive species status, it is apparent there would be a downward trend in numbers of subpopulations and an increase in isolation of subpopulations due to fragmentation of habitat, which could continue throughout most of its range in Region 1. Inherently rare species like *Cyfa* require special status, and their successful management also depends on a Conservation Strategy.

Our increased knowledge of the distribution of *Cyfa* is largely related to the number of surveys that have been conducted for timber management projects planned in its habitat. If those projects were to be carried out without mitigating for the effects on *Cyfa*, some subpopulations would be lost due to direct disturbance, and recolonization of disturbed areas would be slowed. All of these have no doubt already occurred in some portions of the species' range. Continued status as a sensitive species will help to mitigate these adverse effects in the future, until such time that further survey and monitoring results indicate that the species is secure in Region 1.

### **Data management**

Forests should partner with the Heritage Program in their state to reconcile any problems with the way in which observations of *Cyfa* are grouped into occurrences or with the habitat and population information contained in the EOR. In some cases this information may be misleading because it refers to only one of several subpopulations.

### **Documentation of management**

All prescriptive elements connected to *Cyfa* conservation should be documented in the silvicultural prescription and burn plan. The silvicultural prescription is maintained in the stand files, and will be the permanent record of management activities that might affect the conservation of *Cyfa*. It can serve as a source of reference for future land managers.

### **Survey**

Surveys for *Cyfa* should be conducted in all project areas, due to the wide range of habitats occupied. Recent discoveries of populations in dry forests of Idaho point out a need for survey in areas where it may have not been thought necessary in the past.

More survey work should be done in areas linking known occurrences, and also outside project areas where its occurrence is not in conflict with proposed management. Implementation of this Conservation Strategy is based on delineation of metapopulations as management units. Although thorough surveys are time consuming and expensive, management of some occurrences (e.g. Eagle Creek, ID 013 and 087) would benefit from survey of areas linking known occurrences within 0.5 mile of each other.

Comprehensive surveys, based on the species habitat profile rather than project units, could provide a better picture of metapopulation size and structure, and might identify occurrences that could benefit from silvicultural management and/or prescribed fire. Natural Heritage Programs in the two states have a long history of partnering with the National Forests to conduct just these types of surveys. Surveys should be targeted at USFS ownership, outside proposed project areas, and to fit the profile of those stands where *Cyfa* is commonly found. Stands can be identified through the TSMRS database, then stratified further by distance to known occurrences or other parameters.

The greater the consistency in survey data across Region 1, the greater will be its usefulness. Important parameters to record on sighting forms include:

- GPS coordinates for locations of subpopulations
- Approximate genet count (stems also when practical)
- Habitat type

- Associated species
- Degree/range of canopy closure
- Evidence of previous disturbance
- Evidence of potential threats
- Evaluation of individual plant vigor

Negative survey results are also useful in determining metapopulation boundaries and assessing conservation status of *Cyfa*. Data on negative surveys should be kept on a stand basis, and filed with the observation reports.

### Monitoring

Monitoring can be done at various levels appropriate to the objectives. To detect management impacts and adapt management practices accordingly, permanent plots are important, ideally with baseline data collected prior to management. Marked plants, or some explicit definition of a genet, should be used to detect mortality, and monitoring must extend out at least 4 years from the time of disturbance. Long-term (>10-yr) data are the most needed. Plots currently in place should be carefully marked and monumented for revisiting after long time periods.

There is also need for a broader, multi-occurrence monitoring protocol that would help us understand trends across larger areas and augment the fine-scale demographic data now being acquired. A sample subset of populations or clusters could be monitored using GPS technology and rare plant sighting forms or some modification of these.

Current GPS capabilities and improvements in database technology allow NHP/CDC databases to be used for a finer level of plotless monitoring than was previously possible. GPS can be used to pinpoint individual subpopulations, which can then be revisited with a fair degree of accuracy, even though a survey of the entire occurrence is not possible. Data can then be entered as a subpopulation in the EOR.

Habitat description is an important part of population monitoring. Ecodata methods have been widely adopted for recording habitat data in forests and have been used at many *Cyfa* sites. They represent a standard protocol which can help maximize consistency among administrative units and observers. The protocol can be modified to meet objectives of a specific project. Monitoring data will be most useful if collected consistently among plots and among administrative units.

The following parameters are particularly important to monitoring of *Cyfa*:

- Number of stems/approximate number of genets
- Criteria used to define a genet
- Associated species
- Canopy cover by species or by life-form class
- Tree cover by size-class, and how measured
- Total tree cover (by spherical densiometer if possible)
- Phenological stage
- Reproductive status (vegetative, flowering)

- Leaf length
- Plant height (how measured)
- Depth of duff and litter
- Down woody debris—amount and size

Reports documenting monitoring results should be written each year data are collected. Copies of reports should be forwarded to the MTNHP or IDCDC along with updated sighting reports.

### **Research**

Research on a number of questions could assist in managing and planning for *Cyfa* conservation. These include:

- Do plants of dry and moist forest habitats represent different ecotypes? If two different ecotypes are involved, they may respond differently to management.
- With how much confidence can first-year or young plants be distinguished? This would be useful in looking at the affect of habitat and management on recruitment, and in determining the age structure of populations.
- How is the distribution of *Cyfa* related to past fire patterns? That is, has the species benefited from landscape patterns created by large fires in the early 1900s, or from fire suppression in more recent years?
- What are the relative effects spring vs. fall burning on *Cyfa* survival?

### **Adaptive management**

This document summarizes the current status of our knowledge of *Cyfa* and attempts to synthesize that knowledge into a conservation approach. As pertinent additional information accrues concerning the habitat, genetics, population dynamics, and response to management of *Cyfa*, this Conservation Strategy will be amended via appropriate administrative channels.

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## Appendix A

Line drawing of *Cypripedium fasciculatum*

Line drawing of *Cypripedium fasciculatum*  
From: Hitchcock (1969)

## Appendix B

### Maps\*

- Map 1. Global distribution of *Cypripedium fasciculatum*
- Map 2. *Cypripedium fasciculatum* element occurrences, US Forest Service Region 1
- Map 3. *Cypripedium fasciculatum* element occurrences by abundance rank–Idaho, north (selected EOR numbers indicated)
- Map 4. *Cypripedium fasciculatum* element occurrences by abundance rank–Idaho, south (selected EOR numbers indicated)
- Map 5. *Cypripedium fasciculatum* element occurrences by abundance rank–Montana
- Map 6. *Cypripedium fasciculatum* element occurrences by habitat type series–Idaho, north
- Map 7. *Cypripedium fasciculatum* element occurrences by habitat type series–Idaho, south
- Map 8. *Cypripedium fasciculatum* element occurrences by habitat type series–Montana

\* Maps are based on records in MTNHP and IDCDC databases in September, 2002 and may not reflect entries made after that time (EOR# = s.n. in Appendix C).

## Appendix C

Selected data from element occurrence records for *Cypripedium fasciculatum*  
in Idaho and Montana

Appendix C. Selected data from element occurrence records for *Cypripedium fasciculatum* (Source: IDCDC and MTNHP).

EO No.	Survey Site	Elev. (ft)	Last Obs.	AR <sup>1</sup>	Size <sup>2</sup>	Habitat type series	Population Data	Habitat Notes	Ownership <sup>3</sup>
		Min. Max.	Yr.						
ID 001	O'Hara Creek Road	2100	1989	D		Thpl			Nez Perce, Selway RD
ID 002	Aggar Campground	1600	1987	C	1 ac	Thpl			CNF, Lochsa RD
ID 003	Cache Creek	1600	1989	D	1 sq yd	Thpl			Nez Perce, Selway RD
ID 004	Falls Creek	1800	1956	H		Unknown			Nez Perce, Selway RD
ID 005	Tony Creek	2650	1973	D		Thpl			Nez Perce, Moose Creek
ID 006	Fenn Ranger Station	1600	1941	H		Unknown			Nez Perce, Selway RD
ID 007	Lowell	1600	1949	H		Unknown			CNF, Lochsa RD
ID 008	Middle Fork Clearwater R	1710	1972	H		Unknown			CNF, Lochsa RD
ID 009	Little Smith Creek	2100	1994	B	(150 ac)	Thpl	71 plants in 5 subpops		CNF, Lochsa RD
ID 010	Three Devils Creek	1450	1993	C	400 sq ft	Thpl			CNF, Lochsa RD
ID 011	Star Creek	1920	1995	D	50 sq ft	Thpl			CNF, North Fork RD
ID 012	Fernan Hill	2700	1934	H		Unknown			Private
ID 013	Eagle Creek South	3000	1999	B	(40 ac)	Abgr & Thpl	90 in 7 groups		IPNF, Avery RD
ID 014	Rochat Ridge	5500	1934	H		Unknown			BLM, IPNF, St. Maries
ID 015	Manning Creek	2800	1996	A	205 ac	Thpl & Tshe	860 plants/28 subpops	Clun union	CNF, Palouse RD
ID 016	Aquarius RNA-Isabella Landing	1750	1900	D		Thpl		Aquarius RNA	CNF, North Fork RD
ID 017	Twentymile Bar	1650	1989	C	1 - 5 sq yd	Thpl			Nez Perce, Selway RD
ID 018	O'Hara Creek	2160	1993	C	1 - 5 sq yd	Thpl			Nez Perce, Selway RD
ID 019	Lochsa RNA	2600	1989	D		Thpl		Lochsa RNA	CNF, Lochsa RD
ID 020	Mouth of Quartz Creek	2280	1989	D	10 sq ft	Thpl			CNF, North Fork RD
ID 021	Rackliff Campground	1650	1992	C	10-100 sq yd	Thpl	50 plants		Nez Perce, Selway RD
ID 022	Pollock Hill Northwest	4160	1989	C	1 - 5 sq yd	Thpl		Thpl/Gydr	CNF, North Fork RD
ID 023	Isabella Creek	2200	1995	B	<2 ac	Thpl			CNF, North Fork RD
ID 024	Heritage Cedar Grove/ Elmer Creek	3200	1994	D	1-5 sq yd	Thpl			CNF, North Fork RD
ID 025	Pollock Creek	4720	1989	D	1-5 sq yd	Thpl		Remnant Thpl	CNF, North Fork RD

EOR No.	Survey Site	Elev. (ft)		Last Obs.	AR <sup>1</sup>	Size <sup>2</sup>	Habitat type series	Population Data	Habitat Notes	Ownership <sup>3</sup>
		Min.	Max.	Yr.						
ID 026	Mouth of Slide Creek	1800		1984	D		Thpl			Nez Perce, Selway RD
ID 027	Moose Creek R.S. North	2470		1989	D		Thpl			Nez Perce, Moose Creek RD
ID 028	Big Rock Tr. - Shissler Pk South	4400		1989	D		Thpl			Nez Perce, Moose Creek RD
ID 029	Lottie Creek	3240		1989	D		Thpl			CNF, Lochsa RD
ID 030	Hobo Cedar Grove	4300		1990	D	1 sq ft	Thpl	1 plant	Remnant Thpl	IPNF, St. Maries RD
ID 031	Fall Creek	4100	4400	1996	C	9 ac	Abgr	24 plants	Includes blowdown	Nez Perce, Elk City RD
ID 032	Papoose Creek Road	3400	3800	1992	C	5 ac	Thpl			CNF, Powell RD
ID 033	Elk Creek/Cedar Creek	1750		1996	D	9 sq yd	Thpl			Private (Potlatch Corp.)
ID 034	Pete King Creek	1800		1991	D	1 - 5 sq yd	Thpl			CNF, Lochsa RD
ID 035	Nut Creek	3900		1991	D		Thpl			CNF, Lochsa RD
ID 036	FS Trail 708	2700		1991	D	1 sq yd	Thpl			CNF, Lochsa RD
ID 037	Rye Patch Creek	1525	2400	1995	D		Thpl			CNF, Lochsa RD
ID 038	Aquarius RNA - Isabella Landing	1800		1991	C	10 - 100 sq yd	Thpl		RNA. Long-term monitoring plot.	CNF, North Fork RD
ID 039	Selway River Mile 113	1650	1700	1991	D	1-5 sq yd	Thpl			Nez Perce, Selway RD
ID 040	Upper Big Smith Creek	3640	3700	1991	D	1 - 5 sq yd	Thpl			CNF, Lochsa RD
ID 041	Lochsa River-Major Fenn to Bimerick	1680	2200	1995	C	17 sq yd	Thpl			CNF, Lochsa RD
ID 042	Lodge Creek	3620	3940	2001	C		Thpl			Nez Perce, Selway RD
ID 043	Swiftwater Creek	3840		1991	D		Thpl			Nez Perce, Selway RD
ID 044	Lodge Point Northeast	3200		1991	D	1 sq yd	Thpl			Nez Perce, Selway RD
ID 045	Deadman Creek	2200		2002	C	1-3 ac	Thpl	20 plants in 7 subpops.		CNF, Lochsa RD
ID 046	Squaw Creek	3440	3640	1993	B		Thpl	81 plants	Canopy fire (1988)	CNF, Powell RD
ID 047	Canyon Creek	1640	1900	1993	D		Thpl			CNF, Lochsa RD
ID 048	Pete King Creek	2960		1992	D		Thpl			CNF, Lochsa RD
ID 049	Smith Saddle	3280		1992	C	1 ac	Thpl			CNF, Lochsa RD
ID 050	Outfitter Camp	3050		1992	C		Thpl			CNF, North Fork RD
ID 051	Steep Creek North	2640		1992	D		Thpl			CNF, North Fork RD
ID 052	Steep Creek South	2000		1992	D	15 sq yd	Thpl			CNF, North Fork RD
ID 053	West Fork Papoose Ck	3550	4000	1994	B	12 ac	Thpl			CNF, Powell RD
ID 054	Dutchman Creek	3700	3760	1992	D		Thpl			CNF, Pierce RD
ID 055	Badger Creek	3640	3960	1992	B		Thpl			CNF, Powell RD
ID 056	Quartz Creek	3030	3320	1992	C	20 ac	Thpl	25 genets	Thpl/Clun	IPNF, Avery RD

EOR No.	Survey Site	Elev. (ft)		Last. Obs.	AR <sup>1</sup>	Size <sup>2</sup>	Habitat type series	Population Data	Habitat Notes	Ownership <sup>3</sup>
		Min.	Max.							
ID 057	Potlatch River	2700		1994	D		Abgr	4 plants	Pico stand	CNF, Palouse RD
ID 058	Split Creek Bridge	1800		1992	D	10 sq yd	Thpl			CNF, Lochsa RD
ID 059	Lodge Ck Cedar Grove	4280		1998	D	25 sq yd	Thpl		Remnant Thpl	CNF, North Fork RD
ID 060	Chateau Rock Trail	3660		1989	D		Thpl			CNF, North Fork RD
ID 061	NW of Lowell	2880		1993	D	1 sq yd	Thpl			CNF, Lochsa RD
ID 062	Slide Creek	1850	1900	1993	D	30 sq yd	Thpl			Nez Perce, Selway RD
ID 063	Sob Creek	1680	1740	1993	C	25 sq yd	Thpl			Nez Perce, Selway RD
ID 064	Swiftwater Road	1640	2640	2001	B	(160 ac)	Thpl	100 plants	60-yr old stand.	Nez Perce, Selway RD
ID 065	Burnt Creek	1950	2000	1993	D	4 ac	Thpl			Pvt.
ID 066	Handy Creek	2070		1993	C		Thpl			CNF, Lochsa RD
ID 067	Sub Creek East	1700	1750	1993	D		Thpl			CNF, Lochsa RD
ID 068	Sub Creek East	2600		1993	D	1 sq yd	Thpl			CNF, Lochsa RD
ID 069	Pete King Creek	2150	2240	1993	C	10 sq yd	Thpl			CNF, Lochsa RD
ID 070	Upper Big Smith Creek	2400		1997	C	78 sq yd	Thpl		Monitoring plot	CNF, Lochsa RD
ID 071	Fern Creek	2000	3640	1995	C		Thpl			CNF, North Fork RD
ID 072	June Creek	2800	4000	1995	B		Thpl			CNF, North Fork RD
ID 073	Collins Creek Cabin	2440		1993	D	2 sq yd	Thpl			CNF, North Fork RD
ID 074	Warm Springs Creek	3440		1993	C	70 sq yd	Thpl	20 genets	Thpl/Aff HT	CNF, Powell RD
ID 075	Ahrs Gulch	2800	2940	1998	B	2 ac	Psme	150 ramets	60-100% canopy closure. Logging an imminent threat.	Private (Potlatch Corp)
ID 076	Lower Badger Creek	3300	3500	1993	B	10 ac	Thpl			CNF, Powell RD
ID 077	Yakus Creek	3580	3600	1993	D	1 sq yd	Thpl			CNF, Pierce RD
ID 078	Cedar Creek/May Creek	3640		1993	C	110 sq yd	Thpl			CNF, Pierce RD
ID 079	Horse Point NE	2000		1996	C		Thpl		Thpl/Adpe HT	Nez Perce, Selway RD
ID 080	St. Joe River/Bond Creek	2350	2800	1996	B	2 ac	Thpl	79 genets/4 groups	Thpl/Clun, Abgr/Clun	IPNF, St. Maries RD
ID 081	Trail Creek	3300	3880	1993	C	30 sq yd	Abgr			CNF, North Fork RD
ID 082	Syringa Creek	2360	2400	1993	C	320 sq yd	Thpl			CNF, North Fork RD
ID 083	Lower Salmon Creek	2000		1994	C	440 sq yd	Thpl			CNF, North Fork RD
ID 084	Yakus Ck - N of Stray Ck	3350		1994	C		Thpl			CNF, Pierce RD
ID 085	Eldorado Ck/Snow Creek	3240		1994	D	1 sq yd	Thpl			CNF, Pierce RD
ID 086	Lower Crooked Fork Ck	3640	3900	1994	B	0.4 ac	Thpl			CNF, Powell RD
ID 087	Eagle Creek North	3400	4160	1999	B	15 sq yd	Abgr/Thpl	63+ genets/8 subpops	Remnant Psme in part.	IPNF, Avery RD
ID 088	St. Joe River/Bacon Creek	4040		1991	U		Unknown			IPNF, Avery RD

EOR No.	Survey Site	Elev. (ft)		Last. Obs.	AR <sup>1</sup>	Size <sup>2</sup>	Habitat type series	Population Data	Habitat Notes	Ownership <sup>3</sup>
		Min.	Max.							
ID 089	East of Wash Creek	3760	3880	1994	B		Thpl			Nez Perce, Selway RD
ID 090	Fern Creek	2100		1994	D		Thpl			Nez Perce, Selway RD
ID 091	Parachute Creek	4200		1994	D		Thpl			CNF, Powell RD
ID 092	Skookum Creek	2750	2900	1995	D	110 sq yd	Thpl	10 genets	Thpl/Opho	IPNF, Avery RD
ID 093	Black Prince Creek	2900		1995	C	3 ac	Thpl	12 genets in 3 groups	Thpl/Asca; 90% canopy closure	IPNF, St. Maries RD
ID 094	Granite Creek	4040	4300	1996	A	(250 ac)	Psme	688+ genets	Pipo cover type. Partially logged and burned (1994); monitoring plots.	Nez Perce, Clearwater RD
ID 095	Owl Creek West	3070		1995	D	5 sq yd	Thpl			CNF, North Fork RD
ID 096	Malin Creek	2840	3000	1999	B	(10 ac)	Abgr & Thpl	159 genets	Thpl/Opho Thpl/Clun Abgr/Clun; 75% canopy closure.	IPNF, Avery RD
ID 097	Bird Creek	3100	3400	1999	A	1 ac	Thpl & Tshe	~500 plants in several groups.	Timber harvest, monitoring plots.	IPNF, Avery RD
ID 098	Bird Creek/Bernier Creek	3600		1998	D		Thpl	1 plant	Thpl/Clun-Mefe	IPNF, Avery RD
ID 099	Leaning Pine Point	2200		1998	B		Psme	159 stems		Pvt.
ID 100	Trail Creek	2480		1996	C		Thpl	24 genets	Late-seral Thpl/Gydr & Thpl/Adpe	IPNF, St. Maries RD; state. Land exchange.
ID 101	Tourist Creek	3250		1998	D	1 sq ft	Thpl	3 stems		IPNF, Avery RD
ID 102	Footbridge	3000		1999	B	1 ac	Thpl	57 genets/4 groups	Thpl/Adpe, Abgr/Clun	IPNF, Avery RD
ID 103	China Creek Cedar Grove	4550		1998	C	0.5 ac	Thpl		Remnant Thpl	CNF, North Fork RD
ID 105	Searchlight Creek	2850		1999	B	1+ ac	Psme	52 in 2 groups	Pipo-Psme stand	IPNF, Fernan RD
ID 106	Alder Creek	3000		1999	D	2 sq ft	Psme	2 plants		IPNF, Fernan RD
ID 107	Lane Creek	3040		2000	D	200 sq yd	Psme	32 stems	Psme/Phma	IPNF, Fernan RD
ID 108	Long Creek	1620	1640	2000	C		Thpl		Mature Thpl/Adpe	USACE
ID 109	Grandad Boat Launch	1630		2000	D	60 sq yd	Thpl			USACE
ID 110	Telephone Creek	1700		2000	D	1 sq yd	Thpl			USACE
ID 111	North of No-see-um Creek	1650		2000	D	1 sq ft	Thpl			USACE
ID 112	Unnamed Creek N of Nylon Ck.	2440	2460	2000	D	0.1 ac	Thpl			USACE
ID 113	Cranberry Creek	1620		2000	D	1 sq ft	Thpl			USACE
ID 114	Dworshak, SW of Cranberry Ck	1640		2000	D	1 sq yd	Thpl			USACE

EOR No.	Survey Site	Elev. (ft)	Last. Obs.	AR <sup>1</sup>	Size <sup>2</sup>	Habitat type series	Population Data	Habitat Notes	Ownership <sup>3</sup>
		Min. Max.	Yr.						
ID 115	Breakfast/Little North Fork	1670 1680	2000	D	0.1 ac	Thpl			USACE
ID sn	Canfield Butte		2002	C		Abgr	~30 plants in 2 groups.		IPNF, Fernan RD
MONTANA OCCURRENCES									
MT 001	Mission Falls	4680	1976	H					Flathead Indian Reservation
MT 002	Crow Creek		1939	H					
MT 003	Bear Trap Mtn		1917	H					
MT 004	Cedar Creek	4100	1991	A	1 ac	Thpl	200 stems		Private
MT 005	Piper Creek	4000	1991	C	0.5 ac	Thpl	32 plants in 3 groups.	Thpl/Clun	FNF, Swan Lake RD & Pvt.
MT 006	Two Mile Creek	3640 3860	1993	A	1 ac	Abgr	377 plants in 4 subpops.	Long-term monitoring plot 91RS003.	Lolo, Superior RD
MT 007	Tamarack Creek (aka Dry Fork)	3400 4400	2000	B	100 ac	Abgr & Abgr	500-600 pfts in 30 subpops	Portions of 7 different sections.	Lolo, Superior RD
MT 008	McDonald Lake	3600 3840	1992	C	1 ac	Thpl	50-60 plants.	Thpl/Clun	Flathead Indian Reservation
MT 009	Clark Fork/ Falls Creek (Aka Muchwater Quarry)	3100	1993	B	0.5 ac	Psme & Abgr	Eastern subpop: 14 plants. Western subpop: 90 plants.	Psme/Phma Abgr/Libo-Libo	Lolo, Plains/TF
MT 010	South Fork Little Joe T17N,R28W, Sec. 3,9,4,10	3400 4300	1993	A	100 ac	Thpl & Abgr	Many subpops, thousands of stems (all sections).	Extensive additional information on file at MTNHP	Lolo, Superior RD
MT 011	Mullan Gulch	3200 4300	1994	A	1 ac	Psme	307 plants/16 subpops	Psme/Phma	Lolo, Superior RD
MT 012	Cabin City Campground	3320 3360	1992	C	1 ac	Abgr	47 pfts in groups of 2-10	Abgr/Clun-Xete	Lolo, Superior RD
MT 013	Cabin City (aka Boyd Mtn.)	3820 3820	1992	C	1 ac	Psme	21 plants in 2 subpops		Lolo, Superior RD
MT 014	Quartz Creek	3680 4000	2002	B	0.25 ac	Psme	75 plants in 5 subpops	Psme/Phma; plots 92RS005 and 004.	Lolo, Ninemile RD
MT 015	Mullan Creek	4600 4700	1993	B	1 ac	Psme & Abgr	165 plants/5 subpops	Psme/Phma	Lolo, Superior RD
MT 016	Saint Regis T18N, R28W, Sec 25 & 36	3000 3800	1993	B	2 ac	Abgr	148 plants/5 clusters; one lg cluster of 241 stems. Fewer than 50% flowered in 1993. Many non-flowering plants are chlorotic.	Psme/Phma Abgr/Libo	Lolo, Superior RD

EO No.	Survey Site	Elev. (ft)	Last. Obs.	AR <sup>1</sup>	Size <sup>2</sup>	Habitat type series	Population Data	Habitat Notes	Ownership <sup>3</sup>
		Min. Max.	Yr.						
MT 017	Boyd Mountain T18N, R28W, sec 6	4160	1992	C		Psme	21 plants	Psme/Phma. Selectively logged 18- 20 yrs ago & lightly underburned.	Lolo Superior RD
MT 018	McCormick Creek	4000	2001	C	2 sq yd	Psme	37 stems in 1 group.		Lolo, Ninemile
MT 019	Butler Gulch	4200 4300	1996	B	5 ac	Abgr & Psme	130 plants in 2 subpops. Add'l subpops likely.	Psme/Phma Abgr/Libo	Lolo, Superior RD
MT 020	Fourmile Creek	3200 4080	1997	A		Psme & Abgr	900 pfts/11 subpops	Site catalogued completely. Monitoring plots.	Lolo, Superior RD
MT 021	Lower Tamarack Creek (aka Billy Gulch)	3000 3350	2001	A	(2 ac)	Psme	2000: 2000 stems in new subpop (1 ac, Sec 33). 1996: 107 plants/3 subpops. Add'l subpops likely.	Psme/Phma	Lolo, Superior RD
MT 022	Elk Point	4520 4520	1997	C	50 sq yd	Psme	33 plants	Logged in 1979, pre- commercial thinning done in 1982.	Lolo, Plains/Thompson Falls
MT 023	Camp Creek	3600	1998	B	1 ac	Psme	15 plants		Kootenai, Cabinet RD
MT 024	Clark Fork River	2600	2000	D	1 ac	Psme?	4 stems	In shrubby opening.	State of Montana
MT 025	Meadow Creek	4200 4200	2000	B		Psme	56 stems in 5 subpops		Lolo, Superior RD
MT 026	Flat Creek	3000 4200	2002	C	0.5 ac	Psme	47 stems in 2 subpops		Lolo, Superior RD
MT sn	North Fork Little Joe	4450	1993	C		Psme	45 plants in 2 subpops	Psme/Phma/Caru	Lolo, Superior RD
MT sn	Radio tower	3500 3700	2000	C	0.1 ac	Psme	40 plants	Psme/Phma	Lolo, Plains/Thompson Falls
MT sn	Valentine Gulch	3500	2002	B		Psme & Abgr	156 in 2 subpops	Psme/Phma Abgr/Phma	Lolo, Plains/Thompson Falls RD
MT sn	Tamarack	3000 3350	2002	B	5 ac	Psme	107 in 3 subpops.	2002: Stand has been logged and slash present throughout.	State of Montana
MT sn	Welch Gulch	4200	2002	D	20 sq yd	Psme	10 stems	Psme/Phma	Lolo, Superior RD

<sup>1</sup> Abundance rank is based on the estimated number of genets: >200 (A), 50-200 (B), 10-50 (C), <10 (D); H = historical—no data; U = unknown.

<sup>2</sup> Figures in parentheses reflect the extent of the metapopulation and not the size indicated in the EOR.

<sup>3</sup> Clearwater NF (CNF), Flathead NF (FNF), Idaho Panhandle NFs (IPNF), Lolo NF (Lolo), US Army Corps of Engineers (USACE).

## Appendix D

Descriptions of forest stands with *Cypripedium fasciculatum*  
on the Lolo National Forest, Montana

(Key to species name abbreviations follows)

**Two Mile Creek Occurrence (006; abundance rank = A)**

<i>Stand 38-1-43</i>	Stand did not originate from tree harvesting; mix of larch, Douglas-fir, ponderosa pine, lodgepole pine, and grand fir; habitat type is Psme/Vagl/Xete; root rot present; multi-aged stand, 60-150 years.
<i>Stand 38-1-36</i>	Stand is multi-aged; several habitat types in stand; 3 age groups present (10-70, 70-120, 120+ years).
<i>Stand 38-1-47</i>	Multi-aged stand; at least 3 age groups present.
<i>Stand 38-1-41</i>	Multi-aged stand; Douglas-fir, grand fir, lodgepole pine, and ponderosa pine; trees present mostly 9-14 inch dbh.
<i>Stand 38-1-35</i>	Multi-aged stand of Douglas-fir and lodgepole pine; stand originated in 1909.

**South Fork Little Joe Occurrence (010; abundance rank = A)**

<i>Stand 44-2-84</i>	Multi-aged stand; ponderosa pine, larch, and Douglas-fir; partial replacement fire at least a century ago.
<i>Stand 44-2-82</i>	Mainly redcedar, also, grand fir, white pine, and lodgepole, multi-aged stand; habitat type – Thpl/Clun.
<i>Stand 44-2-04</i>	Multi-aged stand, Douglas-fir and ponderosa pine.
<i>Stand 44-2-08</i>	Mainly Douglas-fir, also cedar and grand fir; several habitat types present; average tree age is 150 yrs old.
<i>Stand 44-2-21</i>	Multi-aged stand; grand fir, ponderosa pine, lodgepole pine, and some redcedar; several habitat types present.
<i>Stand 44-2-74</i>	Multi-aged stand; mainly Douglas-fir, also ponderosa pine, lodgepole, and grand fir.
<i>Stand 44-2-75</i>	Multi-aged stand, Douglas-fir and ponderosa pine; one tree was measured at 191 years old.
<i>Stand 44-2-107</i>	Single-story, even aged stand; Douglas-fir, grand fir, larch, and trace of ponderosa pine; habitat types – Abgr/Clun and Psme/Phma/Caru; evidence of some logging 100 years ago.

**Mullan Gulch Occurrence (011; abundance rank = A)**

<i>Stand 9-1-33</i>	Liberation cut in 1952, stand has no exam but surrounding stands have redcedar, grand fir, and lodgepole pine. Thpl/Clun habitat type.
<i>Stand 9-1-83</i>	Psme/Phma/Caru habitat type
<i>Stand 9-2-83</i>	Two-storied stand. Douglas-fir and ponderosa pine overstory, 17 to 30-inch dbh. 130 yrs.old. Douglas-fir saplings around 55 years old. Open, park-like stand. Habitat type is Psme/Phma/Caru

**Cabin City Campground Occurrence (012; abundance rank = C)**

<i>Stand 15-1-149</i>	Mixed conifer stand, mainly Douglas-fir and ponderosa pine. Fire was in stand before the 1910 fire. Habitats are Abgr/Libo and Psme/Phma.
<i>Stand 15-1-151</i>	This is the campground area. It has been salvaged. Habitats include Abgr/Clun, Psme/Vagl, and Thpl/Clun. Has old spring board stumps. Mostly 9 to 12-inch dbh; 110 years old.

**Cabin City (013; abundance rank = C)**

<i>Stand 10-1-58</i>	Selection cut in 1973. Psme/Phma habitat. Multi-stand with two age classes: 60 years and 180 years.
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**Saint Regis (016; abundance rank = A)**

<i>Stand 45-1-01</i>	Mainly Douglas-fir and ponderosa pine, a few larch. Somewhat two-storied stand. Age 90-160 years. 10 to 14-inch dbh Douglas-fir and 12 to 20-inch dbh ponderosa pine. Habitat is Psme/Vaca
<i>Stand 45-1-41</i>	Stand has Douglas-fir, ponderosa pine, and larch. 8 to 20 inch dbh; age 150 years. Habitat is Psme/Phma
<i>Stand 45-1-175</i>	Stand was thinned in 1986. Wildlife burn in top of stand in 1983. Habitat is Psme/Phma.

Abgr	<i>Abies grandis</i>
Caru	<i>Calamagrostis rubescens</i>
Clun	<i>Clintonia uniflora</i>
Libo	<i>Linnaea borealis</i>
Phma	<i>Physocarpus malvaceus</i>
Pipo	<i>Pinus ponderosa</i>
Psme	<i>Pseudotsuga menziesii</i>
Thpl	<i>Thuja plicata</i>
Vaca	<i>Vaccinium caespitosum</i>
Vagl	<i>Vaccinium globulare</i>
Xete	<i>Xerophyllum tenax</i>

## Appendix E

Contacts for information on *Cypripedium fasciculatum*

Contact	Agency	Phone	email
Vick Applegate	Lolo NF	406-329-3763	vapplegate@fs.fed.us
Suzanne DiGiacomo	St. Joe RD, IPNF	208-245-6008	sgigliacomo@fs.fed.us
Carol Ferguson			ferguson@sou.edu
Valerie Goodnow	Fernan RD, IPNF	208-769-3061	vgoodnow@fs.fed.us
Richie Harrod	Okanogon-Wenatchee NF	509-664-2724	rharrod@fs.fed.us
Mike Hays	Nez Perce NF	208-983-4028	mhays01@fs.fed.us
	Montana Natural Heritage Program	406-444-3290	
Dottie Knecht	Okanogon-Wenatchee NF	509-548-6977	dknecht@fs.fed.us
Leonard Lake	Nez Perce NF	208-983-1950	llake@fs.fed.us
Penny Latham	National Park Service		penny_latham@NPS.gov
Darlene Lavelle	Lolo NF	406-329-3800	dlavelle@fs.fed.us
Juanita Lichthardt	Idaho CDC	208-882-4803	jll@moscow.com
Sara Lipow	Oregon Dept. of Forestry	541-945-7389	slipow@odf.state.or.us
Mark Mousseaux	Medford District BLM	541-618-2232	Mark_Mousseaux@blm.gov
Steve Shelly	USFS Region1	406-329-3040	sshelly@fs.fed.us
Nan Vance	USDA-FS; PNW Research Station	541-750-7302	nvance@fs.fed.us

## Appendix F

Photos of *Cypripedium fasciculatum* and its habitat



Source: Lolo National Forest



Aquarius Research Natural Area, 3 June 1996. Source: Idaho Conservation Data Center.



Source: Lolo National Forest



*Thuja plicata*/*Clintonia uniflora* HT; plot 91JL010; EOR 038. Source: Idaho Conservation Data Center.